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August 7, 2013
Project No. 8128.01.12

Mr. Dana Bayuk
Oregon Department of Environmental Quality
2020 SW 4th Avenue
Portland, Oregon 97201-4987

Re: Final *Revised* Fill Zone Well Installation Work Plan
Siltronic Corporation
7200 NW Front Avenue, Portland, OR
ECSI No. 183

Dear Dana:

On behalf of Siltronic Corporation (Siltronic), Maul Foster & Alongi, Inc. (MFA) has prepared this revised work plan describing our proposal to install three monitoring wells in the Fill water-bearing zone (WBZ) on the Siltronic property. Fill WBZ groundwater elevation data will be collected from the monitoring wells during testing and operation of the alluvial hydraulic containment/control (HC/C) system to evaluate the connection between the water bearing zones, and to support the design considerations of the interceptor trench or alternatives for Fill WBZ source control. The work plan was revised in response to and consistent with DEQ comments provided during a meeting on June 11, 2013, and in emails dated June 7 and July 10, 2013. This work plan was subsequently revised consistent with comments received from DEQ in an e-mail on August 6, 2013.

The following sections provide additional detail regarding the rationale for and objectives of the work.

BACKGROUND AND PURPOSE

As directed[1] by the Oregon Department of Environmental Quality (DEQ), NW Natural (NWN) is implementing a groundwater HC/C source control measure for the NWN Site and a portion of the Siltronic property. The design[2] includes a fully penetrating interceptor trench (IT) for controlling and containing groundwater in the Fill WBZ, if needed. The design and

[1] The NWN source control work is being completed consistent with the requirements of: 1) the Joint Order (DEQ Order No. ECVC-NWR-00-27 to NW Natural and Siltronic Corporation (Siltronic), dated October 4, 2000); and 2) the Voluntary Agreement (DEQ No. WMCVM-NWR-94-13, dated August 8, 1994, as amended July 19, 2006).

[2] As described in the January 2012 Revised Groundwater Source Control Construction Design Report, NW Natural Gasco Site and the January 31, 2012 Upper Alluvium Extraction Well Design Work Plan, NW Natural Gasco Site, Portland, Oregon and subsequent related documents.

location of the interceptor trench have not been finalized, but DEQ has required installation of the interceptor trench within approximately six months following full-time operation of the alluvial HC/C system (projected for December 2014).

In the May 2013 monthly meeting, NWN presented a new approach and schedule for testing the Alluvium WBZ HC/C system. During the July 2013 monthly meeting, DEQ discussed expectations for initiating construction of the interceptor trench in the context of the new approach and indicated that initiation of construction should occur no later than six months after beginning the long-term HC/C system testing phase.

DATA NEEDS AND COLLECTION OBJECTIVES

Additional data regarding the hydrogeologic characteristics, including contaminant concentrations, of the Fill WBZ are required to support the design of the IT, or to identify alternative effective source control measures (SCMs). Specific data needs include:

1) Fill WBZ groundwater elevation data.
2) Fill WBZ groundwater chemistry data.
3) Fill WBZ hydraulic conductivity data.

The objective of collecting these data is to quantify critical variables for the design of the IT (or to identify alternatives), which are:

a) Volumetric flux of groundwater in the fill throughout varying river stage conditions, based upon groundwater elevation and hydraulic conductivity data.
b) Contaminant flux in groundwater requiring capture, based upon concentration data and groundwater volumetric flux.

Each of the three proposed monitoring wells, along with the existing Fill WBZ monitoring wells (OW-1-F, OW-2-F, WS-8-33, and WS-9-34) will be utilized to meet the data collections objectives.

MFA understands that NWN, with input from Siltronic, is evaluating additional data needs (e.g., geotechnical) required for the interceptor trench design. However, the work proposed herein is time-sensitive to the initial testing phase and is therefore proposed separately.

The Fill WBZ is primarily composed of dredged sediment from the Willamette River, placed on the upland property (later purchased by Siltronic) and into the nearshore area of the river to expand the property boundaries. The Fill WBZ and underlying Alluvial WBZ are separated by a native silt layer of varying thickness and unknown continuity. In general, the thickness of the silt zone decreases with proximity to the riverbank, and may be absent in places throughout the site.

Figure 1 is an overlay of the current property configuration in the vicinity of the riverbank (e.g., property boundary, Fab 1 building, HC/C wells, and top of bank) on a 1963 aerial photograph of the Site. For reference, the figure also includes the currently proposed placement of the interceptor trench, monitoring wells in the vicinity, and outfall location. The figure demonstrates that much of the current riverbank area adjacent to Fab 1 was originally river, and that the current Fill WBZ occurs within material placed over in-river sediments, not on upland native silt.

A potential discontinuity in the upland silt layer and the in-river sediments underlying the Fill WBZ could influence the hydrogeology of the Fill WBZ. The influence of this discontinuity, and the potential effect on the interceptor trench design, could be inferred from Fill WBZ groundwater elevation data collected during the initial testing phase. TCE present in the Fill WBZ in the TCE supplemental source area may be contributing to concentrations of TCE in the alluvial WBZ.

Drawdown in the Alluvial WBZ induced during the initial testing phase could have a measurable effect in the Fill WBZ, and capturing such data will inform our understanding of the hydraulic connection between the two water bearing zones and potential movement of TCE-contaminated groundwater between the two zones. The influence of the HC/C system on the Fill WBZ was identified by DEQ as a data need for the initial testing phase in their email of April 23, 2013.[3] MFA has included the following additional text consistent with DEQ's August 7, 2013 comments:

> For clarification and context, DEQ's 4/23/13 e-mail provides two lists of data needs for the HC&C system testing: 1) a preliminary list of data needs taken from our August 9, 2012 letter commenting on the Construction Design Report; and 2) a list of example data needs DEQ put together based on interpretations and opinions NW Natural has provided regarding the anticipated response of the Alluvium WBZ to pumping, and the performance of the HC&C system. The potential for the Alluvium WBZ HC&C system to influence the Fill WBZ is included in List #2. In other words, NW Natural has suggested the HC&C system could hydraulically influence the Fill WBZ. DEQ understands Siltronic shares this interpretation. DEQ's 4/23/13 e-mail acknowledges that system testing provides an opportunity to assess this interpretation further.

The additional wells are required to fully evaluate the influence of the HC/C system on the Fill WBZ. The following scope of work is recommended to further characterize the Fill WBZ.

[3] From the email: "DEQ has put together an initial list of example data needs to serve as a starting point for identifying data collection objectives for the initial testing phase:…Further assess the influence of the HC&C system on the Fill WBZ."

SCOPE OF WORK

On the Siltronic property, groundwater in the Fill WBZ is monitored at the riverbank by WS-8-33 and WS-9-34 (WS-9-34 is not shown on the Figure due to its distance from the proposed interceptor trench alignment). NWN recently installed shallow monitoring wells OW-1-F and OW-2-F, both screened in the Fill WBZ. Groundwater in the Fill WBZ is monitored upgradient of the riverbank in four wells (WS-40/41/42/43-36) in the TCE supplemental source area. These wells are located approximately 400 feet upgradient of the riverbank wells. WS-10-27, which is also completed in the Fill WBZ, is located approximately 350 feet upgradient of the source area.

As stated above, additional groundwater data (elevation, gradient, contaminant chemistry, and hydraulic conductivity) between the source area and the riverbank is required in order to support the design considerations of the interceptor trench or alternatives. Based on this data need, MFA recommends completing three borings in the Fill WBZ as monitoring wells; the proposed locations are shown on Figure 2.

BASIS FOR LOCATION AND DESIGN

The proposed locations of the new wells (WS-44, WS-45, and WS-46) are based upon the location of the existing Fill WBZ wells and the need for data between the riverbank and the TCE source area. Wells were located along the presumed groundwater flow path (i.e., from the upland towards the river), in accessible areas (i.e., not obstructed by the Fab 1 building), and in areas not represented by existing Fill WBZ monitoring wells. The basis for locating each well is summarized as follows:

- **WS-44** was located as shown to meet the data collection objectives for an area upgradient of an existing riverbank well (i.e., OW-2-F) and in fill material placed over former open water (i.e., riverward of the historic riverbank) in order to evaluate the potential lithologic controls on groundwater flow.
- **WS-45** was located as shown to meet the data collection objectives for an area representative of fill material placed over native upland material. Along with WS-44 and OW-2-F, data from these three locations can be integrated to evaluate volumetric and contaminant flux changes along a groundwater flow path.
- **WS-46** was located as shown to meet the data collection objectives for an area upgradient of existing riverbank wells (i.e., OW-1-F and WS-8-33) and in fill material placed over an erosion feature (i.e., the former discharge of Morgan Creek). Along with Fill WBZ wells in the source area, OW-1-F, and WS-8-33, data from these locations can be integrated to evaluate volumetric and contaminant flux changes along a groundwater flow path.

MFA reviewed geologic logs for borings completed near the proposed locations to evaluate potential depths and screen intervals, based upon the observed depth to native silt material and saturated soil, respectively[4]. The boring log information is summarized in the following table:

Proposed Well	Proposed Depth (ft-bgs)	Boring Logs Reviewed and Observation Depths (ft-bgs)					
WS-44	**29**	**MW-35U**	**WS-14**	**OW-2-F**	**P1**	**GP99**	**GP4**
Native Silt		28	29	31	31	27	29
Saturated Soil		26	38	21	32	33	29
WS-45	**29**	**WS-23**	**GP98**	**WS-16**	**GP97**		
Native Silt		28	28	38	25		
Saturated Soil		32	23	16	12		
WS-46	**27**	**WS-26**	**GP-02-03**	**WS-27**			
Native Silt		26	28	(1)			
Saturated Soil		40	26	27			

(1) not observed below 20 ft-bgs.
ft-bgs = feet below ground surface

The proposed total depth for each well is based upon the average depth to native silt observed in the nearby wells, but will be adjusted based upon the observed conditions. The wells will be constructed using 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe; 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.010-inch slots. The proposed screen length for the wells is five feet. These construction specifics are intended to be consistent with the construction of the OW-1-F and OW-2-F wells installed by AnchorQEA.

It is expected that the bottom of the screen interval will coincide with the upper elevation of the native silt; however, the monitoring well screens will be placed above the native silt in material representative of the permeable portions of the Fill WBZ (see OW-2F and WS-8-33 for examples). This may or may not result in the bottom of the well screen being placed at the top of the native silt unit. In the case where fine-grain fill material (e.g., sandy gravelly silt [MW-35U], gravelly silt [WS-14], clayey silt [WS23-116]) occurs directly above the native silt unit, the monitoring well screen will be adjusted upward to avoid fine-grained material. In the event fine-grained fill material is present on top of the native silt and shifting the screen upwards results in inadequate groundwater being present in the monitoring well to achieve data collection objectives, the location of the installation will be moved.

[4] Boring logs that were not located near the proposed locations (e.g., OW-1-F) or did not include observations of native silt and saturated conditions (e.g., TG-series) were not included.

INSTALLATION OF MONITORING WELLS

Public and private utility-locating services and other information sources will be used to check for underground utilities before work begins. MFA will coordinate fieldwork to locate possible on-site utilities and piping or other subsurface obstructions.

Preliminary soil borings will be advanced to approximately 30 feet below ground surface in the proposed location of each monitoring well to identify the upper elevation of the native silt. Three monitoring wells will be installed; however, additional borings may be necessary if it is determined in the field that the preliminary boring is not a suitable well location, as discussed in the previous section. Consistent with monitoring wells OW-1F and OW-2F, three or four small holes will be drilled in the bottom of the end caps of WS-44, WS-45, and WS-46 to allow groundwater to drain out of the monitoring wells if groundwater levels decline below the bottom of the installations.

Evaluation of baseline conditions will be performed prior to the HC/C system initial testing phase. The baseline evaluation will include analysis of groundwater levels, groundwater chemistry, and hydraulic conductivity data from the following Fill WBZ monitoring wells: OW-1/2-F; WS-44/45/46; WS-8-33, and WS-9-34.

Soil samples representative of the more permeable fill material will be collected for grain-size testing. Grain-size analyses will be used to document the nature of the material in which monitoring wells are screened and provide additional information on the water-bearing properties of the fill.

DEQ previously approved a pneumatic K-testing approach; however, groundwater levels in the Fill WBZ may not accommodate the use of this method (i.e., insufficient water above the top of the sand pack). A testing approach based on the groundwater conditions observed in the field will be provided to DEQ subsequent to the well installations based on groundwater level measurements from the Fill WBZ monitoring.

SAMPLING AND ANALYSES

Soil borings will be continuously collected during advancement of the boring using methods and equipment previously approved by DEQ and consistent with previous investigations at the site. Organic vapor levels in the soil samples will be measured in the field by the headspace vapor method utilizing a photoionization detector (PID). No soil samples are proposed.

Groundwater samples will be collected from the wells following completion to establish baseline concentrations of chlorinated volatile organic compounds (cVOCs) and other analytes in groundwater. The following analytes or analyte groups are proposed:

- VOCs by EPA Method 8260 (including 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene)
- PAHs (SIM) by EPA Method 8270D and will also include carbazole, dibenzofuran, 1-methylnaphthalene, and 2-methylnaphthalene
- Total cyanide, available cyanide, and free cyanide by EPA Methods 335.4, OIA-1677 and D-4282, respectively
- 6000/7000 Series for total metals (unfiltered, preserved in the field) includes aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc
- Fixed gases (carbon dioxide, methane, ethane, ethane) by American Society for Testing and Materials (ASTM) Method D1945
- Iron (total and dissolved) by inductively coupled plasma (ICP) (United States Environmental Protection Agency [EPA] Method 6010A)
- Organic carbon (total and dissolved) by EPA Method 415.1
- Chloride and sulfate by SW9056

Groundwater (and MGP DNAPL, if required) sampling methods and equipment will be consistent with the current sampling program and in agreement with NWN's monitoring well sampling program in support of the source control measure. Field parameters including temperature, dissolved oxygen, specific conductance, pH, turbidity and oxidation reduction potential will be collected as part of the groundwater sampling events.

Following the baseline sampling, three subsequent quarterly groundwater sampling events will be conducted. The sampling frequency may be adjusted based on project needs, such as the schedule of HC/C system testing.

MFA will receive the data electronically from the laboratory, and the data will be transferred to an EQuIS© database. MFA will perform a quality assurance and quality control (QA/QC) review of the EQuIS© electronic data deliverable file received from the laboratory. The QA/QC review will include the elements of a Tier II data validation review. To document data reliability, a memorandum will be prepared summarizing evaluation procedures, the usability of the data, and deviations from specific field and/or laboratory methods.

Groundwater elevation data will be collected from the proposed wells using transducers. The transducers will be synchronized with the OW-series transducers to the extent needed to evaluate changes in Fill WBZ groundwater induced by changes in river stage and/or the HC/C initial testing.

REPORTING

After the data have been received and evaluated, MFA will discuss the results and identify next steps with DEQ.

SCHEDULE

MFA is prepared to schedule and commence work immediately following DEQ approval. We request that DEQ respond to this approach as soon as possible in order to be able to collect baseline conditions prior to the initial testing phase.

Sincerely,

Maul Foster & Alongi, Inc.

Kerry-Cathlin Gallagher
Project Scientist

James G.D. Peale, RG
Principal Hydrogeologist

Attachments: Figures

cc: Myron Burr, Siltronic Corporation
Alan Gladstone, Brian Church, William Earle - Davis Rothwell Earle and Xochihua, P.C.
Chris Reive, Jordan Ramis
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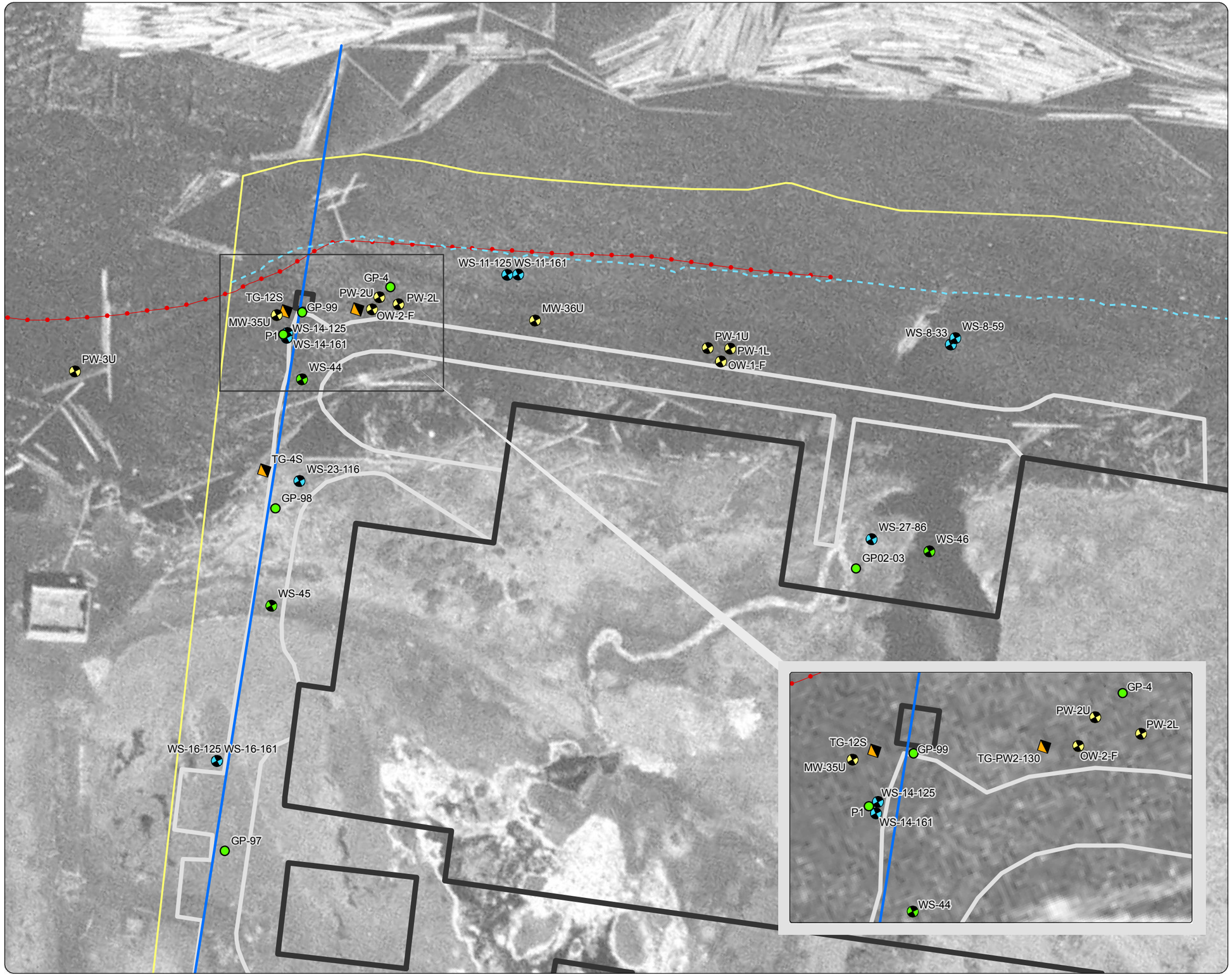
Henning Larsen, DEQ
Matt McClincy, DEQ

FIGURES

Figure 1
1963 Aerial and Current Site Features

Siltronic Corp.
Portland, Oregon



Legend

- Proposed Monitoring Well
- MFA Siltronic Monitoring Well
- Gasco Station
- TarGOST Boring (Approximate)
- Geoprobe Locations
- Outfall (Approximate)
- Proposed Trench
- Top of Bank (Approximate)
- Extent of Pavement (2013)
- Current Building Footprint (2013)
- Siltronic Tax Lot (2013)

Note: Proposed monitoring well locations subject to modification based on field conditions

0 30 60
Feet

Source: Historical Aerial source is unknown.

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Figure 2
Proposed and Existing Monitoring Wells

Siltronic Corp.
Portland, Oregon

Legend

- Proposed Monitoring Well
- MFA Siltronic Monitoring Well
- Gasco Station
- TarGOST Boring (Approximate)
- Geoprobe Location
- Tax Lot

Note: Proposed monitoring well locations subject to modification based on field conditions.

0 30 60
Feet

Source: Aerial photograph obtained from ESRI, Inc. ArcGIS Online/Bing Maps

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